

DEPROTECTION OF BENZALDEHYDE DIACETATES
BY CERIC AMMONIUM NITRATE COATED ON SILICA

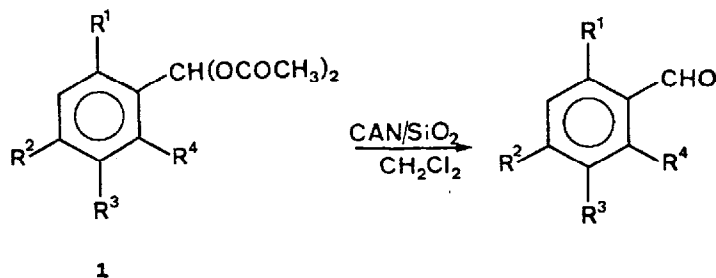
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ABSTRACT: Benzaldehyde diacetates were selectively converted to the corresponding benzaldehydes using Ceric Ammonium Nitrate (CAN) coated on silica in dichloromethane.

For decades, the strong oxidising properties of Ceric Ammonium Nitrate (CAN) have been shown to be extremely useful in synthetic organic chemistry¹. For the oxidation of hydroquinone dimethyl ethers to the corresponding quinones² and for benzylic oxidation³⁻⁵, CAN has proved to be an ideal reagent because of the mild conditions involved. It has also been employed adsorbed on silica gel for oxidative nitration of polynuclear arenes⁶ and oxidation of hydroquinones⁷. CAN has been used to effect deprotection of ketones which have been protected as 1,3-dithiolanes or 1,3-dithianes⁸. The benzaldehyde diacetate protection has been successfully used by Tomita and coll,⁹ but has not yet become a useful method due to the unselectivity of the acylation reaction. Recently, we have used this protection to modify selectively the orientation of the nitration of 2,5-dimethoxybenzaldehyde¹⁰. In this paper, we wish to report the use of CAN on silica⁷ for the selective deprotection of benzaldehyde diacetates.

We reacted several benzaldehyde diacetates 1 (prepared from the benzaldehydes in acetic anhydride quantitatively¹⁰) with CAN/SiO₂ in dichloromethane¹¹ (Table, Scheme 1).

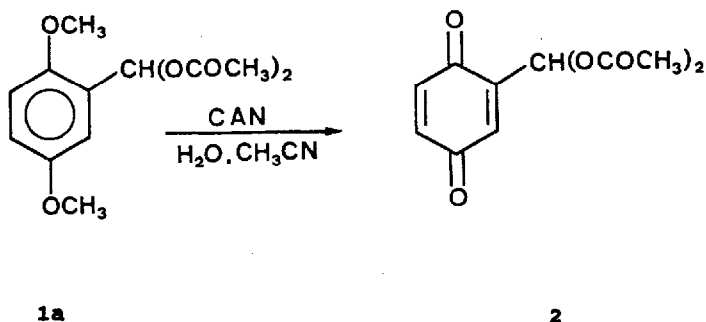


Scheme 1

Deprotection occurs selectively on 4-acetoxybenzaldehyde diacetates **1b** and **1c** without cleavage of the phenolic acetate protection, which was previously reported by Chawla¹² (1,4-diacetoxybenzene reacts with CAN in methanol/acetic acid to give nitrohydroquinone and hydroquinone). 1,4-Diacetoxybenzene does not react in the presence of CAN/SiO₂ (All attempts to cleave aromatic and aliphatic acetates has failed). These differences are not unexpected because of the drastic conditions used by Chawla.

Whereas for dimethoxybenzenes¹³, nitration with CAN/SiO₂ in dichloromethane occurred giving good yields of mononitrated compounds, no nitrated compound was obtained for **1a**.

1a showed no sign of reaction with silica in methylene chloride and was thus completely recovered from the reaction mixture, but reaction of **1a** with CAN in an acetonitrile/water solution afforded the benzoquinone-1,4-aldehyde diacetate² **2** (scheme 2) in 96% yield (all attempts to deprotect **2** proved to be futile).



Scheme 2

The addition of 1ml of water or methanol to the deprotection mixture (CAN/SiO₂ in methylene chloride) gave a mixture of 2 and 2,5-dimethoxybenzaldehyde (10/90) from 1a (90% yield).

These results show that for deprotection it is necessary to coat Ceric Ammonium Nitrate onto silica. When oxidative demethylation can occur, the reaction must be carried out in the absence of a protic solvent to avoid the formation of benzoquinone.

Table: Deprotection of benzaldehyde diacetates 1 and benzoquinone-1,4-aldehyde diacetate 2 by CAN/SiO₂

Substrate	R ¹	R ²	R ³	R ⁴	Yield(%) ^a
1a ¹⁴	OCH ₃	H	OCH ₃	H	92
1b ¹⁵	H	OCOCH ₃	H	H	98
1c ¹⁵	H	OCOCH ₃	OCH ₃	H	90
1d ¹⁰	OCH ₃	NO ₂	OCH ₃	H	94
1e ¹⁰	OCH ₃	H	OCH ₃	NO ₂	95
2					0 ^b

a. Yields of pure compounds.

b. 2 was recovered in 95% yield.

To sum up, we have found that CAN/SiO₂ in an aprotic solvent proves useful for the selective deprotection of benzaldehyde diacetates to give benzaldehydes. The aryl acetate function (compounds 1b and 1c) does not react whereas in acidic¹⁶ or alkaline¹⁷ conditions, it is readily cleaved.

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11. Typical procedure: Substituted benzaldehyde diacetate (1, 1mmol) in dichloromethane (15ml) is added with stirring to the CAN/SiO₂ (6.94g, 2.1mmol of Ce(IV)). The mixture is stirred for 15 min and filtered. The residue is washed with dichloromethane (2*15ml). Evaporation of solvent from the combined filtrates gives an oil. Addition of hexane (2*15ml) (to remove the acetic acid) and evaporation gives substituted benzaldehyde which is found to be pure by ¹H-N.M.R.
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